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I. **Solution by ALFRED HUME, C. E., D. Sc., Professor of Mathematics, University of Mississippi, University, Miss.**

An arrow rises $4\frac{1}{2}$ seconds when shot vertically, and therefore, the initial velocity which Hiawatha is able to impart to an arrow is $\frac{9}{2}g$ feet per second.

The angle of elevation for the longest range is 45°, and therefore, the horizontal component of the velocity of the arrow is $\frac{1}{4}(9\sqrt{2})g$. This being Hiawatha's speed, his time for 100 yards is a very little less than 3 seconds.

In the above it has been assumed that Hiawatha ran the whole distance at a uniform rate. The range is much more than a hundred yards.

II. **Solution by S. ELMER SLOCUM, Union College, Schenectady, N. Y.; J. P. BURDETT, Class '97, Dickinson College, Carlisle, Penn.; and E. W. MORRELL, A. M., Professor of Mathematics, Montpelier Seminary, Montpelier, Vt.**

Let t=time of flight when the arrows are shot vertically upward, and u be the initial velocity. Then $t=2u/g$, and $u=\frac{1}{2}gt=144$ feet per second.

The range of a projectile is $u^2\sin2\theta/g$, and since the greatest value of $\sin2\theta$ is 1, the maximum range is u^2/g.

$\therefore$ Range$=u^2/g=648$ feet. Time of flight for projectile is $2u\sin\theta/g$ $=6.363$ seconds.

$\therefore$ Velocity$=648\div6.363=101.8+$ feet per second.

Time for 100 yards$=(300\div101.8+)=2.94$ seconds.

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AVERAGE AND PROBABILITY.

Conducted by B. F. FINKEL, Springfield, Mo. All contributions to this department should be sent to him.

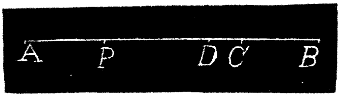
SOLUTIONS OF PROBLEMS.

52. **Proposed by B. F. FINKEL, A. M., M. Sc., Professor of Mathematics and Physics, Drury College, Springfield, Missouri.**

A straight line of length a is divided into three parts by two points taken at random; find the chance that no part is greater than b. [From *Hall and Knight's Higher Algebra.*]

I. **Solution by HENRY HEATON, M. Sc., Atlantic, Iowa.**

There are two cases. I, when $b>\frac{1}{3}a$ and $<\frac{1}{2}a$, and II, when $b>\frac{1}{2}a$ and $<a$.



Case I. Let AB represent the line a. Let P be the position of the first point, and let $AP=x$. Lay off PC and BD each$=b$. Then the favorable positions for the second point lie between C and D. $DC=x+2b-a$. The limits of x are $a-2b$ and b.

Hence the required chance is $P_1=\frac{1}{a^2}\int_{a-2b}^{b}(x+2b-a)dx=\frac{(3b-a)^2}{2a^2}$.

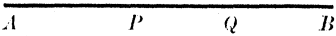
Case II. In this case the limits of x are 0 and $a-b$.

$$\text{Hence, } P_2=\int_0^{a-b}(x+2b-a)dx=\frac{(3b-a)(a-b)}{2a^2}.$$

Corollary. When $b=\frac{1}{2}a$, $P_1=P_2=\frac{1}{8}$.

II. Solution by J. O. MAHONEY, B. E., M. S., Graduate Fellow and Assistant in Mathematics, Vanderbilt University, Nashville, Tenn.

Let AB be the straight line of length a, and let the random points P, Q be at distances x, y from A, so that $AP=x$, $AQ=y$, and $PQ=a-x-y$. In favorable cases we must have $x<b$, $y<b$, and $a-x-y<b$; and in possible cases $x+y<a$.



Construct the right-angled triangle ABC where $AB=AC=a$. With A as origin and AC and AB as axes construct the lines MN, LH, and RS, whose equations are $y=b$, $x=b$, and $x+y=a-b$, respectively. (1) When $b>\frac{1}{2}a$, the favorable cases will be restricted to the area $MNHLSR$ in Fig. 1, and the required chance is $1-3[(a-b)/a]^2$. (2) When $b<\frac{1}{2}a$, the favorable cases will be restricted to the area 123 in Fig. 2. This is a right-angled isosceles triagle a side of which is $AM-SL=b-(a-2b)=3b-a$. Therefore, the required chance is $[(3b-a)/a]^2$.

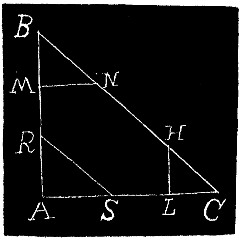


Fig. 1.

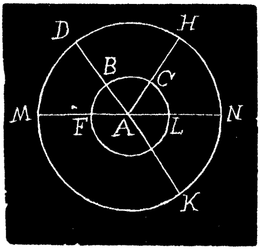
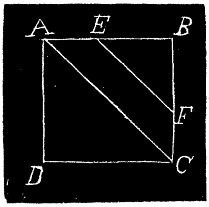


Fig. 2.

III. Solution by G. B. M. ZERR, M. A., Ph D., President and Professor of Mathematics, Russell College, Lebanon, Va.

Let $ABCD$ be a square side a, and take $AE=CF=b$. The coördinates of a point taken at random in $ABCD$ are the distances of two such points from one end of the line.

Without restriction the point might fall anywhere upon ABC, but the condition confines it to the triangle EBF.



$$\therefore\ p=\frac{EBF}{ABC}=\frac{(a-b)^2}{a^2}=\left(\frac{a-b}{a}\right)^2.$$

$$\text{Otherwise } p=\frac{\int_b^a\int_0^{y-b}dydx}{\int_0^a\int_0^y dydx}=\left(\frac{a-b}{a}\right)^2.$$

Professors Scheffer and Zerr should have received credit in the last number of the MONTHLY for solving problem 50, and Professor Henry Heaton should have received credit for solving problem 51.

No solution of problem 53 has yet been received.